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EXAMINER	
LAZORCIK, JASON L	
ART UNIT	**PAPER NUMBER**
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/789,074	GREYWALL, DENNIS S.	
	Examiner	Art Unit	
	Jason L. Lazorcik	1731	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 August 2007 and 23 July 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22,26-28 and 40-49* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-22,26-28 and 40-49* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *3/28/2005*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☒ Other: *IDS filed:6/13/2005, 7/23/2007*.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims **1, 3, 6, 8, 9, 10, 19, 20, 21, 26, 28, 40, 42, 45, and 47** are rejected under 35 U.S.C. 102(b) as being anticipated by Roeder (DE 3,516,920 – *Note rejections are based upon the machine translation*). Support for the following rejection can be found in the accompanying machine translation sections ([P1, L1-13]; [P1, L18 to P2, L7]; [P2, L41-65]; [P3, L26-40]; [P4, L38-42]; [P5, L42 to P6, L6]).

1) The reference teaches producing a composite article comprising glass and carbon particles or "carbon fibrils" (**Claim 3**) "whose core zone is unidirectionally strengthened with continuous fibers". These fibers are "oriented by the structure...to the longitudinal axis of the semi-finished material" or substantially aligned (**Claim 26, 28, 40**)

2) The disclosed process is characterized by "impregnating (a carbon fiber) bundle to form a "glass containing carbon particles" (Claim 8) and it teaches that this body may be fabricated in accord with the "Sol-Gel" process (**Claim 9, 10**). During the process, the body may be imbued with an alcohol in addition to the glass powder or "at least one other material" (**Claim 13**). The reference teaches that this preform may be

of low density (e.g. porous) and that it is advantageous to "consolidate the impregnated preform before (extruding the composite article)" (**Claims 12, 14**)

3) The composite article is formed from the heated preform by "a combined extruding and pulling through procedure" (**Claim 6**). As taught in the instant reference, the preform body is incorporated into a larger body which is made at least in part of glass and which has a hole and atleast one other body (**Claims 15, 16, 18**). Upon the disclosed heating, the preform and glass body are "consolidated" (**Claim 17**), and by the extruding and pulling procedure, at least some of the glass is removed from the exterior portion of the carbon fiber by a mechanical process (**Claims 19, 20, 21**).

In view of Applicants claim amendments submitted in the response dated July 23, 2007 and August 2, 2007, additional comments regarding the content of the Roeder disclosure are hereafter made with respect to the English language translation of German document DE 3,516,920 (Please note a copy of the translation is included along with the instant correspondence).

Roeder teaches that in a preferred embodiment of the invention, carbon particles (e.g. filaments) are obtained from a stock fiber comprising many individual carbon

particles. Specifically, the reference teaches (pages 22-23 of English language translation) that;

> "The fibers are delivered in the form of continuous-fiber strands, comprising 500 individual fibers...provided with a sizing for protection and for better handling. Since the sizing ... prevents penetration of the glass powder between the filaments) it must be removed by immersion in a solvent or burned off by means of a Bunsen burner flame. At a temperature of ca. 600°C the individual filaments separate from one another. Prepared in this way, the fibers are now cut to a suitable length and combined into a fiber bundle, which comprises a large number of fiber strands."

It is evident from the above excerpt that the stock carbon material utilized in a preferred embodiment of the Roeder invention may take the form of a relatively large, "prefabricated" carbon fiber. This "prefabricated" fiber is separated into individual carbon filaments or "carbon particles" before to being subjected to the prior art infiltration process.

After separating the prefabricated bundle into individual filaments or "carbon particles" Roeder teaches that said filaments are cut to length and subsequently grouped into loose, bundles of fibers. Further, Roeder teaches (Page 14 of English language translation) that "The fiber bundle can be impregnated either by a suspension

process...or by the sol-gel method (German Patent No 1941191 ...), wherein the fiber bundle is immersed in a solution of metal alcoholates." This sol-gel impregnation process is implicitly understood to encompass Applicants claimed step of dispersing the carbon particles in a sol-gel solution (**claim 42, 45**) and "solidifying" at least a portion of the sol-gel solution to "form a glass body containing therein said carbon particles". Finally, Roeder discloses that "during extraction from the hollow mandrel, the glass-impregnated fiber bundle Is pre-compacted in the point of the hollow mandrel, which is tapered in the pulling direction" (Page 12 of English language translation).

It follows from the above series of excerpts that the Roeder discloses impregnating separated or loosely bundled carbon filaments (e.g. carbon particles) with a sol-gel solution to form a glass containing carbon particles. Further, it is the Examiners understanding that this glass with embedded carbon particles is "pre-compacted" during the drawing operation to yield a compacted carbon fiber from the separated or loose carbon filaments.

Claims 12, 13, 14, 15, 16, 17, 18, 43 and 46 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Roeder (DE 3,516,920 *machine translation and English language translation*).

Claim 43, 46, 48 requires that the drawing step of the glass impregnated carbon fibers results in " a plurality of aligned carbon fibers" and the said drawing step results in the expulsion of "glass located between and within said aligned carbon fibers. As

discussed in the rejection under 35 U.S.C. 102(b) presented above, Roeder teaches that the drawing process results in carbon fibers which are substantially aligned parallel to the direction of drawing and further teaches that the drawing results in "pre-compaction" of the glass impregnated carbon fiber perform.

Roeder does not explicitly require that entrained glass is "expelled" from the glass infiltrated carbon fibers during this "pre-compaction" step. With this point in mind, it is the Examiners assessment, absent any compelling evidence to the contrary, that the claimed "expelling" action is either implicitly achieved during the disclosed compaction process or alternately that such an action would have presented an obvious extension over the prior art teachings. Specifically, the reference teaches that it is known to compact the relatively low density glass impregnated carbon fibers to achieve a properly densified carbon reinforcement core in the produced glass fiber. It would have been obvoius to one of ordinary skill in the art at the time of the invention to adjust the chosen level of compaction by expelling entrained glass in order to achieve the requisite level of fiber core densification or pre-compaction.

With respect to **Claims 12, 13, 14, 15, 16, 17, and 18**, the instant claims require in part the formation of a porous carbon/glass perform wherein more than one material infiltrates the carbon fibers, heating the perform to consolidate it, incorporating said perform into an apparatus having a hole sized to receive the body wherein said apparatus further comprises an additional body. As pointed out in the rejection under 102(b) above, the Roeder reference explicitly teaches each of the aforementioned

limitations in a preferred embodiment of the invention with specific reference to the glass powder impregnated carbon particles (e.g. filaments).

The reference teaches that a sol-gel based infiltration method may be utilized to achieve substantially identical results to the preferred embodiment, however the reference does not make explicit all of the details of the alternate sol-gel embodiment of the invention. It is the Examiners express position that the claimed limitations making use of the sol-gel infiltration process represent a merely trivial extension over the prior art teachings that would have been a merely obvoius matter for one of ordinary skill in the art at the time of the invention.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 4,5, 7, 44, and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Roeder and the general teachings of Hearle et al. (as presented by Zhang et. al., Science v306, no. 5700, (2004), pp 1358-1361)).

The Roeder reference is silent regarding the performance of a twisting operation upon the fiber in the heated state. Zhang relates the following with reference to Hearle;

"a generic equation (*9*) provides useful insights for spinning nanotube yarns. Specifically, the ratio of yarn tensile strength (σ_y) to the tensile strength of the component fibers (σ_f) is approximately

$$\sigma_y/\sigma_f \approx \cos^2\alpha[1 - (k\,\mathrm{cosec}\,\alpha)] \quad (1)$$

where $k = (dQ/\mu)^{1/2}/3L$, α is the helix angle that fibers make with the yarn axis, d is the fiber diameter, μ is the friction coefficient between fibers, L is the fiber length, and Q is the fiber migration length (i.e., the distance along the yarn over which a fiber shifts from the yarn surface to the deep interior and back again).

The $\cos^2\alpha$ term in Eq. 1 describes the strength decrease of a twisted assembly of continuous fibers, which occurs because the fibers in the twisted yarn are inclined at the angle α with respect to the tensile axis. For short fibers, however, in the absence of twist there is little strength because there are no significant transverse forces to bind the fiber assembly together. The $[1 - (k\ \mathrm{cosec}\ \alpha)]$ term describes the generation of transverse forces by transfer of the tensile load to the yarn surface, which locks the fibers together as a coherent structure. The components of k show that the strength obtainable for a given level of twist increases with increasing coefficient of friction and fiber length and with decreasing fiber diameter and fiber migration length.

Effectively, Hearle teaches that twisting a fiber greatly increases the tensional rupture strength of the produced fiber over non-twisted fibers. It would have been obvious for one of ordinary skill in the art at the time of the invention with the Roeder and Hearle teachings in hand to twist the fiber as produced according to the Roeder

method. This would have been an obvious modification to anyone seeking to increase the strength of the fiber.

Claims 22 is rejected under 35 USC 103(a) as being obvious over Roeder (DE 3,516,920) as applied to Claim 19 under §35 USC 102(b) above.

Roeder is silent regarding the use of a chemical process to remove at least a portion of the exterior glass from the from the carbon fiber. That said, the literature is replete with "chemical processes" (e.g. hydrogen fluoride) which provide a controlled etch of glass from a substrate. One familiar with the Art would reasonably be expected to recognize the impact of the thickness of an exterior coating upon the physical properties of the produced fiber. It would have been obvious for one of ordinary skill in the art at the time of the invention to utilize a "chemical process" to remove a portion of this external coating in order to achieve the desired thickness in the exterior glass layer of the as produced carbon fiber. The chemical removal of a portion of the exterior glass layer would have been an obvious approach to tailor the physical properties of the produced fiber by thinning the exterior glass coating.

Claim 11 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Roeder as applied to Claim 45 under 35 USC 102(b) and in further view of Chandross (US 5,240,488).

Roeder is silent regarding the addition of an ester (e.g. at least one other material") to the carbon particle/ sol gel mixture as set forth in the instant claim.

Chandross Claim 4 teaches that "the pH-decreasing ingredient is added to the sol prior to introduction of the sol into the mold, and in which the pH-decreasing ingredient consists essentially of an ester whereby the rate of gelation is controlled". It would have been obvious to one of ordiary skill in the art being aware of the Chandross teachings to add an ester to a sol-gel mixture in order to control the rate of gellation of the sol. Where the rapid gellation of the sol in the Roeder process may lead to an unsuitably heterogeneous carbon particle preform, the addition of an ester would have been an obvious modification to the sol for one seeking to prolong the infusion period by extending the gellation time period.

Claims 2, 27, and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Roeder as applied under 35 USC 102(b) to claim 1, 26, and 40, respectively in further view of Kumar (Macromolesules 2002, 35, 9039-9043).

Roeder is silent regarding the use of carbon nanotubes as the carbon particles in the disclosed method for assembling carbon particles. Kumar recites multiple previous studies which confirm the "benefits of reinforcing polymer and other matricies with carbon nanotubes". The instant reference figure 4, 5, and 6 point to beneficial advantages in the composite structures including a reduced thermal shrinkage, reduced weight loss with temperature, and an enhanced creep behavior at elevated temperature for the composite over virgin matrix material. It would have been obvious for one of ordinary skill in the art at the time of the invention, being aware of the confirmed benefits

of reinforcing a matrix with carbon nanotubes, to substitute said nanotubes for the disclosed carbon fibers in the Roeder invention.

Response to Arguments

Applicant first argues that the Roeder reference utilizes an "already formed fiber bundle" wherein said "prefabricated fiber bundle" is impregnated with glass and placed into a hollow mandrel. Applicant acknowledges that the glass impregnated fibers are drawn through the mandrel to form a glass rod having a fiber reinforced core. Applicant further acknowledges that prior to the impregnation step, Roeder teaches a heat treatment step wherein "the spooled fibers is stripped off and the individual filaments of each fiber are loosened from one another". Applicant asserts that the "already existing, previously formed carbon fiber" taught in the prior art reference does not adequately read on applicants claimed invention wherein "glass is drawn to form a carbon fiber from carbon particles contained int eh glass with the fiber being formed as the glass is being drawn.

The Examiner strongly disagrees.

As presented in the rejection above, although the prior art reference may make use of a "preformed" fiber bundle as a raw starting material, a preliminary step in the disclosed process utilizes a burner or solvent to break apart the preformed fiber into individual, separated filaments. This point is directly acknowledged by Applicant in the on page 6 of the reply filed August 2, 2007, and the Examiner is in full agreement with

Applicants assessment of the prior art. Roeder subsequently teaches that after infiltration with a glass material, these carbon filaments are compacted by the drawing operation to form a carbon fiber reinforced core for the composite glass/carbon fiber. Applicants arguments alleging that Roeder does not teach the formation of a central carbon fiber from carbon particles (e.g. carbon filaments) amounts to a mischaracterization of the scope and content of the prior art reference.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason L. Lazorcik whose telephone number is (571)

272-2217. The examiner can normally be reached on Monday through Friday 8:30 am to 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven Griffin can be reached on (571) 272-1189. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JLL

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